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ABSTRACT

The conceptual and problem solving skills of Hawaiian rural elementary school students in the Kamehameha Early Education Program were investigated by comparing the logical connecting rules of conjunction (red and triangle) to inclusive disjunction (red and/or triangle) with respect to Traditional problems (selection of attributes from 2 different dimensions and connecting them via a logical rule) vs. Intradimensional problems (selection of attributes from the same dimension and connecting them via a logical rule). Background information briefly sketches learning paradigms, logical connecting rules, and Traditional and Intradimensional problems. Among the results briefly discussed was the major finding that the Intradimensional problems were easier to solve than the Traditional problems and that the children solved the Intradimensional problems on the basis of the simplest available rule. A surprising finding was that children did not find conjunction easier than disjunction. (SE)

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Technical Report # 75

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The Kamehameha Early Education Program

The Kamehameha Early Education Program (KEEP) is a research and development program of The Kamehameha Schools/Bernice P. Bishop Estate. The mission of KEEP is the development, demonstration, and dissemination of methods for improving the education of Hawaiian and Part-Hawaiian children. These activities are conducted at the Ka Na'i Pono Research and Demonstration School, and in public classrooms in cooperation with the State Department of Education. KEEP projects and activities involve many aspects of the educational process, including teacher training, curriculum development, and child motivation, language, and cognition. More detailed descriptions of KEEP's history and operations are presented in Technical Reports #1-4.

Abstract

A group of rural Hawaiian children were presented with two kinds of conjunctive and disjunctive conceptual problems. One kind (Traditional) could be solved only via a conjunctive or disjunctive rule, while the second kind (Intradimensional) could either be solved conjunctively or disjunctively, or on the basis of a simpler logical rule. Surprisingly, the Hawaiian children at all age levels did not find conjunction easier that disjunction. A tentative suggestion is hypothesized in the present paper to account for this finding. A major finding of the present paper is that rural Hawaiian children, as young as six years old, found the Intradimensional problems easier than the Traditional problems. This finding was traced to the ability of the Hawaiian children to solve the Intradimensional problems on the basis of the simplest available rule. In this regard, the performance of the Hawaiian children compares quite favorably with the performance of a group of upper and middle class white children living in New York City, as reported in earlier research.

Technical Report # 75

The Influence of Rule Structure and Problem Composition on Conceptual Learning among Rural Hawaiian Children[1]

Tom Ciborowski D. Price-Williams

This brief report is the first in a series of studies focusing on the conceptual and problem solving skills of a group of rural Hawaiian children. Since the present study is the first in a series we sought to attempt to replicate one of the more robust findings in the experimental literature on childrens' conceptual learning. At the same time, we sought to attempt to replicate with rural Hawaiian children a study recently conducted by Ciborowski and Cole (1973) that used subjects both in New York City and in Liberia, West Africa. Hence, one of the purposes of the present study was to test the generalizability of the findings of Ciborowski and Cole.

In most studies of conceptual learning the investigator first selects a relevant attribute from two different dimensions (say redness, triangularity from the color, form dimensions) and joins them via some logical rule to constitute the "concept" (Bourne, 1970; King & Holt, 1970; Bourne & O'Banion, 1971; Ciborowski & Cole, 1972; Paris, 1973). Typically, the rules that are selected are conjunction (e.g., red and triangle) and inclusive disjunction (e.g., red and/or triangle). If the subject is told beforehand what the two relevant attributes are, the task is called Rule Learning. If the subject is told beforehand what the logical connecting rule is, then the task is called Attribute Identification. Finally, if the subject is not told beforehand either the relevant attributes or the logical connecting rule, then the task is called Complete Learning.

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Most studies of conceptual learning with children have used either the Rule Learning paradigm or the Complete Learning paradigm. It has generally been found that adults and children, even as young as six-years-old, learn a conjunctive rule faster (less errors) than a disjunctive rule (King, 1966; Paris, 1973; Ciborowski & Cole, 1973; Haygood & Bourne, 1965). In the present study we first sought to investigate whether a group of rural Hawaiian children would also find conjunction easier than disjunction using a Complete Learning paradigm. The present study however, was patterned after Ciborowski and Cole (1973), and differed in a major way from the work of the researchers cited above.

In the present study the conceptual problems presented to the children were constructed in two fundamentally different ways. One problem was constructed in the typical way of selecting an attribute from two <u>different</u> dimensions and connecting them via a logical rule. This problem was termed a Traditional problem. The other problem was constructed by selecting two attributes from the <u>same</u> dimension (e.g., triangularity and circularity) and likewise connecting them via a logical rule. This second type of problem was termed an Intradimensional problem. Because of the type of construction of the Intradimensional problem, this problem could be solved in <u>two</u> different ways. It could be solved via our reference rules of conjunction or disjunction, or it could be solved via a simpler logical rule such as affirmation. And by simpler logical rule we mean simpler in the sense introduced by Neisser and Weene (1962). In the interests of brevity the Intradimensional problem will not be described further in this brief technical report, the interested reader can find an <u>exhaustive</u> description in Ciborowski and Cole (1973).

The critical question concerning the Intradimensional problem is whether the children would detect the simpler rule embedded in the problem and solve on that basis.

The present study was conducted in Pidgin (or Hawaiian Islands Dialect). Pidgin is a major dialect of the English language and it shares many of the same features of other Creole variants of the English language (Carr, 1972). We adhere to current linguistic convention in considering Pidgin and Standard English as merely different dialects of the English language, with no implication that one dialect is linguistically more complex than the other. In the present study the instructions were translated from Standard English into Pidgin and the experiment was conducted in Pidgin by a Hawaiian research assistant that is verbally skilled in both Pidgin and Standard English.

Method

Subjects

A total of 70 rural Hawaiian schoolchildren participated in the experiment. There were 22 children in the age range of 6 to 7-years-old (median age 6 years, 5 months); 24 children of median age 9.0 years; and 24 children of median age of 12 years, 3 months. All the children attend the Hookena Elementary School located in south Kona on the Big Island of Hawaii. The children are predominantly Hawaiian in ancestry and live in the remote fishing village of Milolii. A complete description of these children can be found in earlier technical reports in this series.

Stimuli

The stimuli consisted of a Traditional problem (relevant attributes were redness, triangularity) and and Intradimensional problem (relevant attributes were triangularity, circularity). Both problems were constructed of colored geometric figures on white 3" x 5" cards. There were 72 cards for each problem which included an equal number (18) of each of Bourne's (1970) truth-table classifications. That is, an equal number of TT (true-true), TF (true-false), FT (false-true), and FF (false-false) instances. Here, "true" and "false" are used in place of the "presence" or "absence" of the relevant

attributes, respectively. In the interests of brevity a full description of the stimuli will not be given here. An exhaustive description can be found in Ciborowski and Cole (1973).

Procedure

The entire experiment was conducted in Pidgin by a Hawaiian research assistant that is verbally skilled in both Pidgin and Standard English.

The stimuli were completely described to the subjects. The subjects were told that there was some rule which divided the cards into two piles. The subjects were told that it was their task to discover the rule. At the beginning of each problem the subject was shown an example of a card (TT) that went on the subject's left, and an example of a card (FF) that went on the subject's right. The subject was told that the experimenter would present the cards one at a time, and that the subject had to say whether the card went on the left or right side. After the subject indicated his response the experimenter told the subject if the choice was correct or incorrect, and then the experimenter placed the card on the correct pile. If the subject achieved 10 correct responses in a row it was assumed that the subject would make no further errors and the problem was terminated, otherwise the subject received all 72 cards. At the end of each problem the subject was asked to verbalize the basis of his solution.

Design

All the subjects received just two problems, a Traditional problem and an Intradimensional problem. The two problems were presented in a counterbalanced order across subjects. A subject received either two disjunction problems or two conjunction problems.

Results

The primary measures of performance were the number of errors committed and the subjects' own verbalizations of their basis of problem solution. The

error data was submitted to an analysis of variance.

The analysis revealed a significant main effect for age, $F(2,64) = 4.29$, $p < .01$. A Newman-Keuls test revealed that the six- to seven-year-olds committed significantly more errors than the 12-year-olds, $q(3,48) = 4.18$, $p < .01$, but not the nine-year-olds. There were no other significant differences between the three age groups.

Analysis also revealed a significant interaction between age and type of conceptual rule, $F(2,64) = 3.07$, $p < .05$. A series of Newman-Keuls tests revealed that for the six- to seven-year-olds, conjunction was more difficult than disjunction, $q(2,22) = 3.64$, $p < .05$; and, for the conjunctive rule, the six- to seven-year-olds committed significantly more errors than the nine-year olds, $q(4,24) = 4.28$, $p < .05$. There were no other significant differences of interest in the interaction shown in Table 1.

Analysis also revealed that the Traditional problems (20.8 mean errors) were more difficult than the Intradimensional problems (10.5 mean errors), $F(1,64) = 50.11$, $p < .01$.

Discussion

The major finding of the present study was that a group of rural Hawaiian schoolchildren, some as young as six-years-old, found the Intradimensional problems easier to solve than the Traditional problems. An examination of the subjects' own verbalizations of their basis for solving the problems revealed that they solved the Intradimensional problems on the basis of the simplest available rule. That is, instead of solving the Intradimensional problem either conjunctively or disjunctively, they solved on the basis of the "built-

Table 1

Mean Number of Errors as a Function of

Age and Conceptual Rule Type

	Conceptual Rule	
Age	Conjunction	Disjunction
6-7-years-old	23.1	15.0
9-years-old	14.0	16.6
12-years-old	13.9	11.7

in" simpler rule. This performance is comparable to the performance of middle-class white children in New York City, and far superior to the performance of a group of West-African tribal children as reported in Ciborowski and Cole (1973).

A somewhat surprising finding was that for the Traditional problems, conjunction was not easier than disjunction. This finding however, is not unique in the literature (cf., Bourne & O'Banion, 1971; King & Holt, 1970).

The children in the present study received only one Traditional problem and one Intradimensional problem. This procedure was followed so as to minimize the length of time each child was out of the classroom. In most studies of conceptual learning the subject receives at least four or five problems to solve. Each problem is considered a trial. The difference in performance between conjunction and disjunction is generally obtained, and becomes more robust, as trials increase. Hence, it is tentatively suggested that if the children in the present experiment received more than just one Traditional problem (say at least three), perhaps the customary superiority of conjunction over disjunction might be obtained. Studies now in progress may support this tentative suggestion. Another possible difficulty inherent in presenting just one problem of each kind, is that there may be negative transfer between the Intradimensional problem and the Traditional problem. Studies now being planned will explore this possibility.

To repeat, the major finding of the present study is that a group of rural Hawaiian children solved the Intradimensional problems on a level highly comparable to a group of middle class white children in New York City.

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